STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

A REPORT OF A SURVEY OF EARTH-BORNE TRUCK VIBRATIONS ADJACENT TO AND AROUND MASTERTON'S HOUSE

JULY 1966

State of California
Highway Transportation Agency
Department of Public Works
Division of Highways
Materials and Research Department

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Lab. Auth. 19201-762600-32824
Masterton vs. State
SCC No. 834963

Mr. R. B. Pegram, Deputy Chief Counsel
Division of Contracts and Rights of Way
Legal Section
Room 1100, 3540 Wilshire Boulevard
Los Angeles, California 90005

Attention: Mr. J. M. Lisi, Attorney

Dear Sir:

Submitted for your consideration is:

A REPORT OF

A SURVEY OF EARTH-BORNE TRUCK VIBRATIONS

ADJACENT TO AND AROUND MASTERTON'S HOUSE

Study made by . . . . . Structural Materials Section
Under supervision of . . . . . E. F. Nordlin
Report prepared by . . . . . J. E. Barton and W. Chow

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

JEB/WC:mw
cc: Dist. 07
JMLisi
JTWebster

I. INTRODUCTION

This survey was initiated by Attorney J. M. Lisi, Division of Contracts and Rights of Way, Department of Public Works, Los Angeles, by his letter dated May 16, 1966, to Mr. J. T. Webster, District 07 Materials Engineer.

The object of this survey was to determine the present magnitude of earth-borne truck vibrations around Mrs. Masterton's house which is adjacent to the San Diego Freeway. The house is located at 7320 Piper Avenue, Los Angeles, California. Mrs. Masterton has alleged that since construction of the San Diego Freeway her house has suffered structural damage due to earth-borne truck vibrations.

II. FINDINGS

The maximum vibration caused by traffic on the Freeway shoulder during this survey was 0.00045" and adjacent to the Masterton house was 0.000". The U. S. Bureau of Mines Bulletin #442 indicates that such vibrations must be at least 0.10" before concern is necessary as to house damage. Thus it appears remote that damage to the Masterton house could have resulted from Freeway traffic.

III. TEST PROCEDURE

The test procedure consisted of recording earth-borne truck vibrations at various locations around Mrs. Masterton's house and on the shoulder and retaining wall of the Freeway.

IV. DISCUSSION

A damage suit has been filed against the State of California by Mrs. Masterton who is the owner of the house located at 7320 Piper Avenue, Los Angeles, California. Mrs. Masterton alleges damages to her house caused by vibrations from the adjacent San Diego Freeway resulting in cracking of the house walls and foundations.

This survey was concerned mainly with the transmission of earth-borne vibrations from highway truck traffic. The minimum distance between a corner of the claimant's house and the highway pavement edge is 75 feet. Traffic was moderately heavy during this survey on June 30, 1966. Average traffic velocity during the survey was approximately 65 mph. Heavy-truck traffic was in the order of 10% of the total vehicle traffic.

A vibration tester was used to pick up vertical earth-borne vibrations due to truck traffic. Exhibit 2 shows the tester and its recorder.

Each time that a large truck passed by Mrs. Masterton's property on the outside lane, the vibration tester recorder was turned on to record any vertical earth-borne vibrations emanating from the truck passage. Eight different locations, one at a time, were monitored this way. Locations monitored are shown on Exhibit 3, and Exhibits 4 and 5 are photographs of the 8 locations.

Exhibit 1 tabulates the 80 earth-borne vibration records of the trucks passing by Mrs. Masterton's house. No vibrations were measurable around Mrs. Masterton's house or on the retaining wall as shown on Runs 1 through 62. Vibrations were measurable at Location 8 alongside the traveled way. The largest vibration was in Run #69 with a movement of 0.00045" peak-to-peak at a frequency of 25 cps. The average for the 18 runs at Location 8 was 0.00015 inches peak-to-peak displacement and at an average frequency of 34 cps.

In the proceedings issued by the Highway Research Board, 13th Annual Meeting 1950, H. B. Sutherland in his "A Study of Vibrations Produced in Structures by Heavy Vehicles" states on page 417 "that the vibrations from heavy vehicles in Winnipeg do not produce harmful effects to the structures". This was based on his observations of vertical vibrations in the magnitude of 0.0004" to 0.004" peak-to-peak displacement inside of a stucco house but without damages to it.

Note that the largest vibration measured was alongside the freeway edge, Location 8, Run #69, and it was 0.00045" at 25 cps. This maximum vibration value was just at the threshold of concern of Sutherland's study and would certainly be dissipated in the distance from the freeway edge to Mrs. Masterton's house.

Bureau of Mines Bulletin #442 indicates that the peak to peak displacement vibrations should be in excess of 0.10" before concern is necessary as to house damage. The largest vibration measured was 0.00045", alongside the freeway at Location 8, and was 222 times less than the Bureau of Mines

damage-caution criteria. This criteria would indicate that a house alongside the freeway, at Location 8, would not be subject to structural damages from freeway earth-borne vibrations.

Mrs. Masterton has stated that her chandelier lamp by her front window, Location 6, would "tinkle" due to passage of heavy trucks. The vibration tester was placed on this outside window sill and no recordable vibrations were picked up. It is well known that a passage of a heavy truck can cause glass window panes to rattle from air-borne sound and yet cause no house structural damage. Similarly, sonic booms and wind can shake and rattle a house and yet not structurally damage it.

For a comparison, the window sill was rapped lightly with a corner of a clipboard. Run #42 shows that the window sill vibrated at a peak to peak displacement of 0.00012" at a frequency of 50 cps. This is in the same order of magnitude as the average vibration level (0.00015" at 34 cps) alongside of the freeway. It is well known that the activities of the inhabitants of the house (opening and closing of doors, windows, walking around, etc.) will create house vibrations equal or larger than that created by rapping on the window sill and yet not structurally damage the house.

In terms of the layman, how large is the average vibration level alongside of the freeway? The answer is provided in Run #43 at Location 5 where the concrete was tapped with a foot approximately 1 foot away from the vibration tester. Note that this foot tapping created a vibration displacement level equal to the average vibration displacement level alongside the freeway.

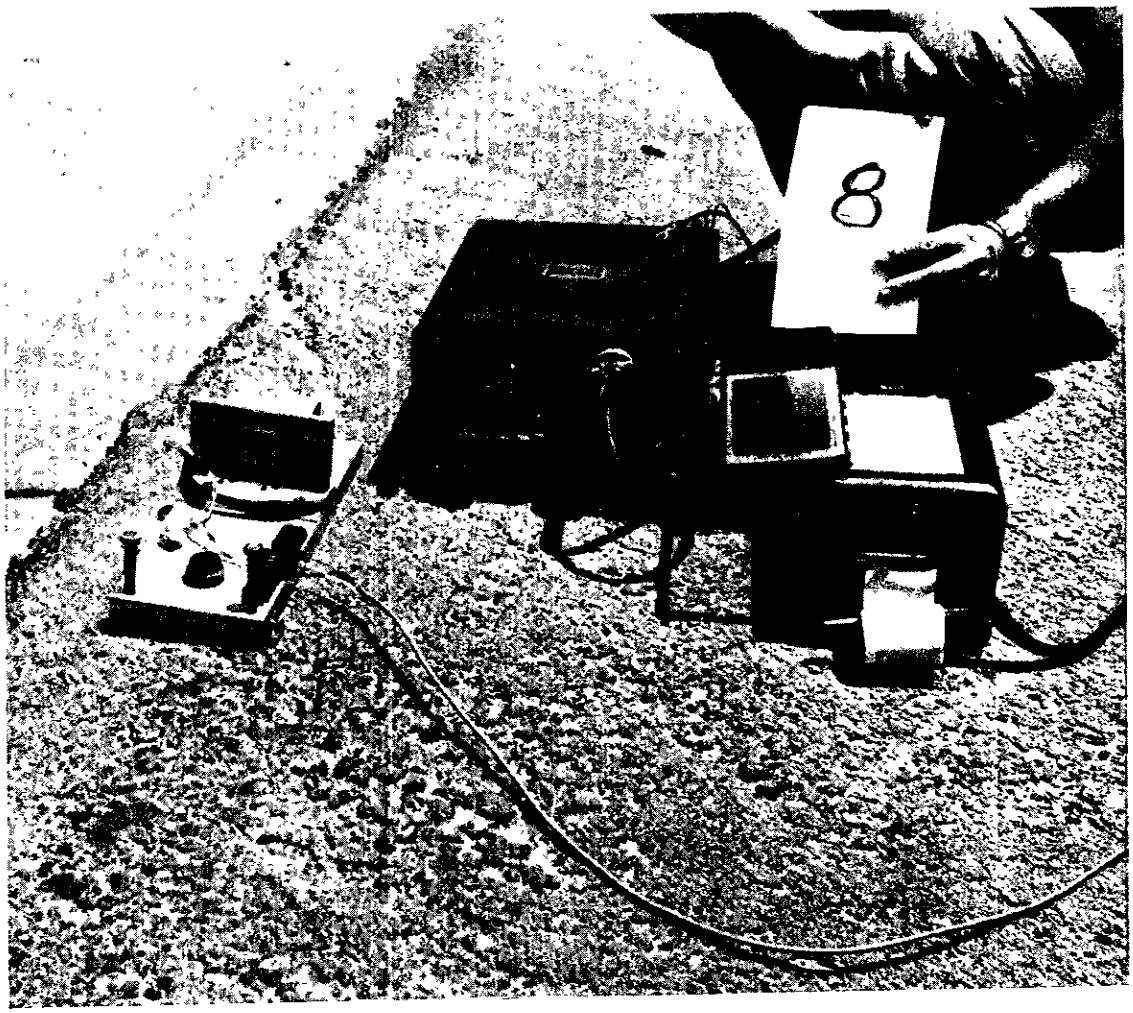
VERTICAL VIBRATION MEASUREMENTS AT 7320 PIPER AVE., LOS ANGELES, CALIF.
June 30, 1966

Displacement given in inches peak to peak. Frequency given in cycles/sec. (cps). No vibrations indicated by - - .

RUN	LOCATION	VIBRATIONS DISPLACEMENT	CPS	TRUCK TRAFFIC
1	1	- -	- -	No traffic.
2	1	- -	- -	Concrete mixer transit
3	1	- -	- -	3 axle flatbed with 55 gal. drums.
4	1	- -	- -	Lumber truck.
5	1	- -	- -	Truck and trailer loaded with gravel.
6	1	- -	- -	No traffic.
7	1	- -	- -	No traffic.
8	1	- -	- -	Two trucks
9	1	- -	- -	SP 5 axle truck and trailer.
10	1	- -	- -	Gasoline tanker - 5 axle.
11	2	- -	- -	Truck and trailer - 5 axle.
12	2	- -	- -	Cement hopper and trailer.
13	2	- -	- -	Cement hopper, trailer, concrete transit.
14	2	- -	- -	Truck and trailer loaded with gravel.
15	2	- -	- -	Truck and trailer loaded with gravel.
16	2	- -	- -	5 axle truck with 3" pipe.
17	2	- -	- -	Cement hopper and trailer.
18	2	- -	- -	Gasoline tanker and trailer.
19	2	- -	- -	3 axle gasoline tanker.
20	2	- -	- -	Truck and trailer - 5 axle.
21	3	- -	- -	Truck and trailer - 5 axle.
22	3	- -	- -	Truck and trailer - 5 axle.
23	3	- -	- -	Two 3-axle flatbed trucks.
24	3	- -	- -	Truck and trailer - 5 axle.
25	3	- -	- -	Molasses tanker and trailer.
26	4	- -	- -	Truck and trailer loaded with gravel.
27	4	- -	- -	2 axle van.
28	4	- -	- -	3 axle garbage truck.
29	4	- -	- -	Loaded 5 axle flatbed truck and trailer.
30	4	- -	- -	5 axle truck & trailer aggregate hopper.
31	5	- -	- -	Two 3-axle flatbed trucks.
32	5	- -	- -	4 axle flatbed truck - loaded.
33	5	- -	- -	3 axle van and 5 axle truck and trailer.
34	5	- -	- -	3 axle concrete mixer with drum turning.

RUN	LOCATION	VIBRATIONS DISPLACEMENT	CPS	TRUCK TRAFFIC
35	5	- -	- -	Truck and trailer hopper loaded w/sand.
36	5	- -	- -	5 axle truck and trailer tanker.
37	6	- -	- -	Concrete mixer.
38	6	- -	- -	Loaded flatbed with canned goods.
39	6	- -	- -	Loaded aggregate hopper and molasses tankers.
40	6	- -	- -	3 axle truck.
41	6	- -	- -	Flatbed truck loaded with crane parts.
42	6	.00012	50	Tapping window sill with clipboard.
43	5	.00015	50	Tapping concrete with foot 1' from tester.
44	7	- -	- -	Allied Van Line and oil drilling rig.
45	7	- -	- -	Truck and trailer aggregate hopper.
46	7	- -	- -	No record.
47	7	- -	- -	No record.
48	7	- -	- -	No record.
49	7	- -	- -	No record.
50	7	- -	- -	Concrete mixer transit.
51	7	- -	- -	Flatbed truck.
52	7	.00001	40	Chevron 5 axle tanker and trailer.
53	7	- -	- -	4 axle van.
54	7	- -	- -	Tanker and trailer.
55	7	- -	- -	3 trucks in a row.
56	7	- -	- -	3 axle van.
57	7	- -	- -	3 axle concrete mixer transit.
58	7	.00002	33	5 axle truck and trailer rock hopper.
59	7	- -	- -	Air Products liquid gas.
60	7	- -	- -	5 axle truck and trailer.
61	7	- -	- -	3 axle concrete mixer transit.
62	7	- -	- -	Dump truck.
63	8	.00035	22	5 axle tanker and trailer.
64	8	.00015	22	Truck.
65	8	.00018	29	Truck and trailer aggregate hopper.
66	8	.00013	33	3 axle truck and trailer.
67	8	.00015	36	3 axle truck and trailer.
68	8	.00007	50	3 axle truck.

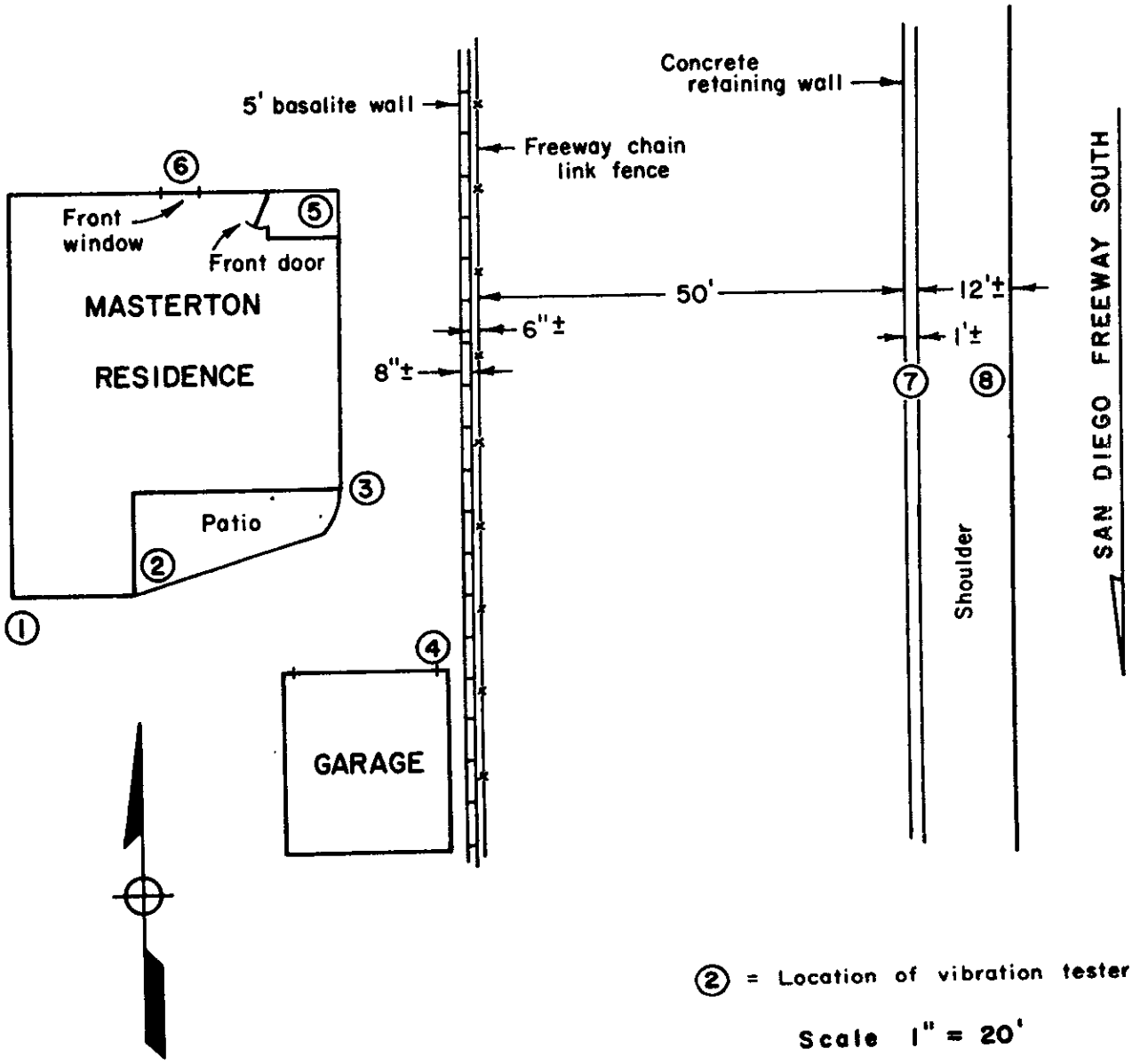
RUN	LOCATION	VIBRATION DISPLACEMENT	CPS	TRUCK TRAFFIC
69	8	.00045	25	5 axle rock hopper.
70	8	.00010	40	3 axle truck.
71	8	.00018	33	Concrete mixer transit.
72	8	.00006	36	3 axle truck.
73	8	.00001	50	All lanes with passenger cars.
74	8	.00018	25	3 axle van.
75	8	.00009	36	4 axle truck and trailer.
76	8	.00015	40	Cement hopper.
77	8	.00012	33	Concrete mixer transit.
78	8	.00010	36	Concrete mixer transit.
79	8	.00010	29	3 axle truck.
80	8	.00012	33	Truck with boat.

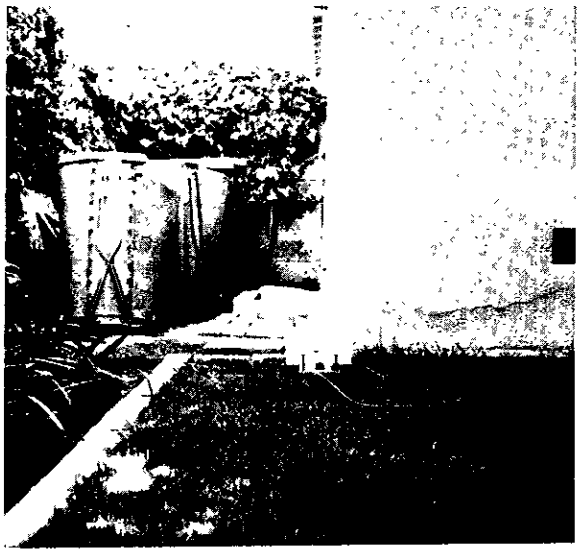


View of tester and recorder.

MEASUREMENTS OF TRUCK INDUCED EARTH-BORNE VIBRATIONS AT THE MASTERTON PROPERTY – 7320 PIPER AVENUE, LOS ANGELES, CALIFORNIA.

— PLAN VIEW OF VIBRATION TESTER LOCATIONS —

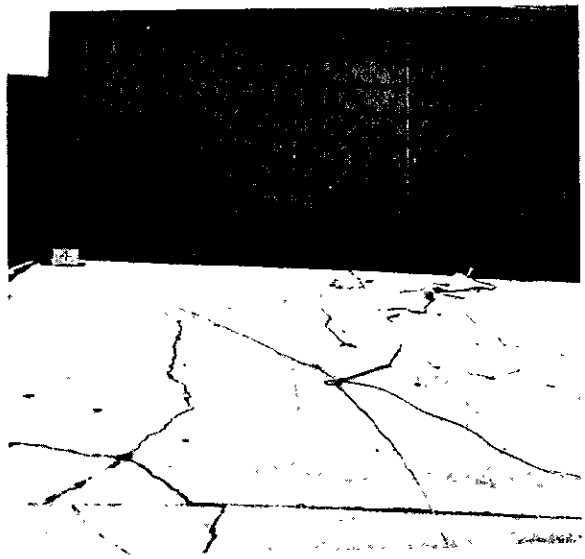




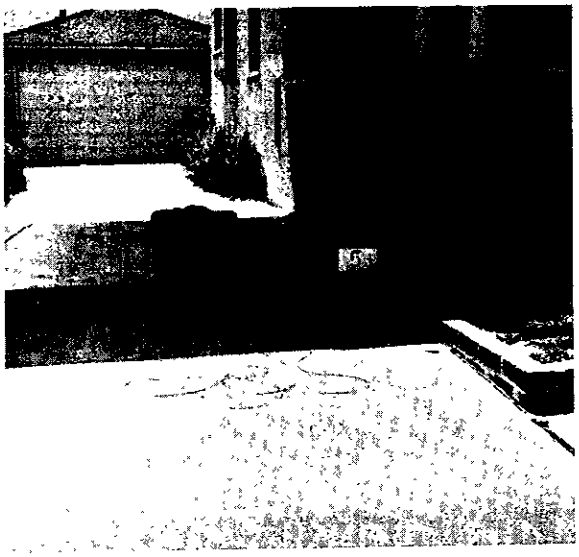
Location 1

Location 2

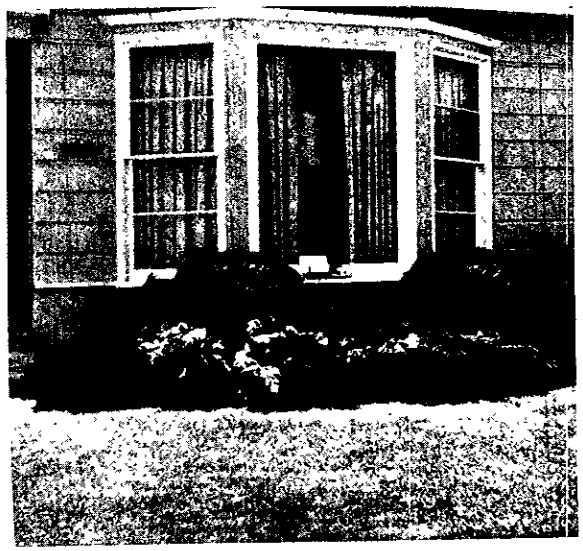
Location 3



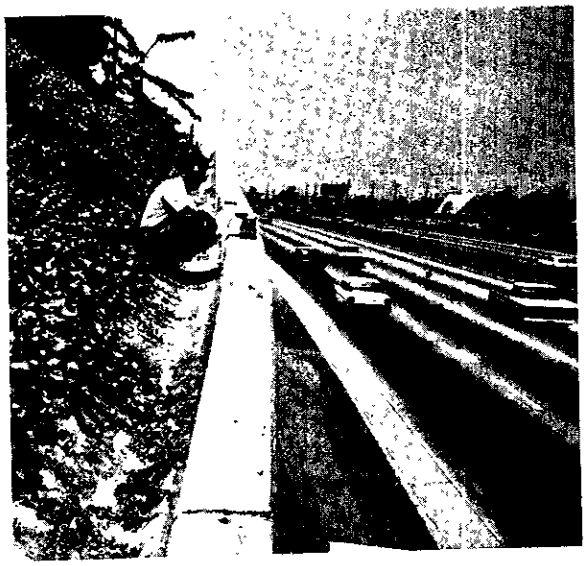
Location 4



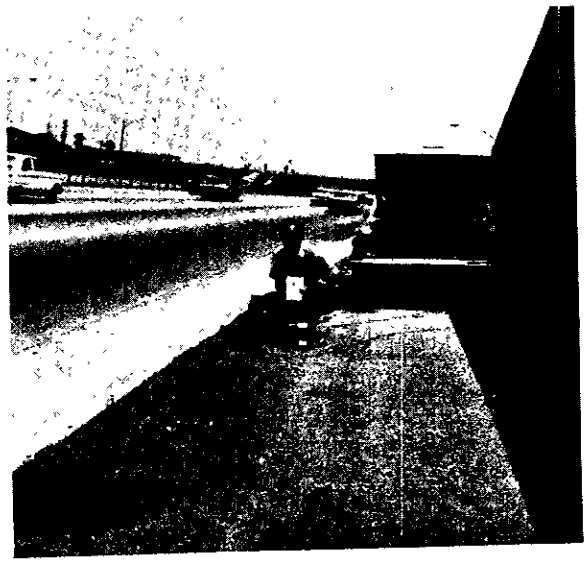
Location 5



Location 6



Location 7



Location 8